

A NEW CRETACEOUS MAYFLY FROM BURMESE AMBER (EPHEMEROPTERA: AUSTRALIPHEMERIDAE)¹

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ABSTRACT: The new genus and species, *Nanophemera myanmarensis* McCafferty and Santiago-Blay, is described from an adult mayfly of the extinct family Australiphemeridae imbedded in Burmese amber, probably of Upper Cretaceous age. *Nanophemera* is the fifth genus known in the Australiphemeridae (a Pangaean, Cretaceous family), which is hypothesized to represent a primitive group of small-sized, tusked, burrowing mayflies (Scaphodonta), possibly closely related to the extant family Potamanthidae. *Nanophemera* is among the smallest known burrowing mayflies at slightly over four millimeters in length, and it differs from related genera by details of its cubital and anal venation systems in the forewings. The newly described fossil is the second mayfly discovered from Burmese amber.

KEY WORDS: Ephemeroptera, Australiphemeridae, *Nanophemera*, fossil, Burmese amber, Cretaceous, new genus and species

The family Australiphemeridae was erected by McCafferty (1991) for the fossil genera *Australiphemera* McCafferty and *Microphemera* McCafferty from Lower Cretaceous [Santana Group, Crato Member or Formation, circa 108-92 Ma; late Aptian to Cenomanian (Martill 1993, Rasnitsyn and Zherikhin 2002) Brazilian shale impressions (McCafferty 1990)]. McCafferty (1997a) placed the genus *Palaeoanthus* Kluge from Upper Taimyr Peninsula (Siberian, age data controversial, exact location of deposits within Upper Cretaceous unclear; Eskov 2002) amber (Kluge 1993) in this family and Sinitshenkova (2000a) included the genus *Borephemera* Sinitshenkova from Upper Cretaceous New Jersey amber (Sinitshenkova 2000a) in the Australiphemeridae. Thus, the family has been known as a strictly extinct, broadly distributed group from the Cretaceous. The family is known only from alate mayflies, but based on wing venation, it has a basal phyletic position within the ephemeroteran suborder Furcatergalia (infra-order Scaphodonta - the tusked burrowing mayflies, McCafferty 2004) and may be most closely related to the extant family Potamanthidae. The family Australiphemeridae includes mayflies with a relatively small body size for Scaphodonta, and in the forewings a somewhat weakened MP₂ basal arch, and an A₁ with no attaching veinlets distally and none or only one basally.

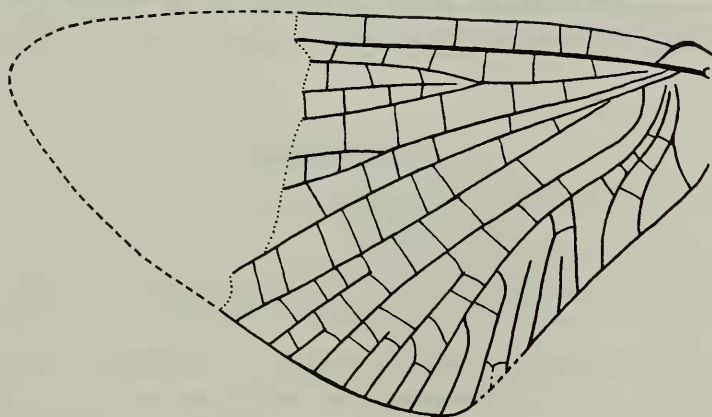
We have recently discovered and herein describe an additional new genus of Australiphemeridae represented by an adult individual fossilized in Cretaceous Burmese amber. Sinitshenkova (2000b) considered the age of another Burmese mayfly fossil specimen as Upper Cretaceous. Age range estimates for Burmese amber have varied (Eskov 2002) from early Upper Cretaceous (Grimaldi et al.,

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2002, Zherikhin and Ross 2000; Cenomanian, approximately 90-100Ma) to late Lower Cretaceous (Cruikshank and Ko 2003, Ross and York 2004, Rasnitsyn to Santiago-Blay, pers. comm. March 2008; Upper Albian, approximately 100 Ma). Among a rather extensive arthropod fauna that has been found from Burmese amber (Rasnitsyn and Ross 2000), only one mayfly had been known, and it was described as a new genus of the extant mayfly family Prosopistomatidae by Sinitshenkova (2000b). Prosopistomatidae are members of the suborder Carapacea (McCafferty 1997b, McCafferty and Wang 2000, Sun et al., 2006), along with Baetiscidae (extant and Tertiary) and the extinct family Cretomitarcyidae.



Figures 1-2. 1. *Nanophemera myanmarensis* fossil habitus. R₁ evidently folded underneath Sc in both forewings. 2. *Nanophemera myanmarensis* forewing. R₁ evidently folded underneath Sc in both forewings.

Nanophemera, NEW GENUS

Diagnosis. Adult, sex unknown. Very small sized for mayflies with typical scaphodont wing venation, i.e., with forewing with MP_2 and CuA with arched base (Figs. 1 and 2). Forewing with MA forked near mid-length of wing; MP_2 basal arch moderate; CuA with intercalaries not sigmoidal, with some intercalary veins attached and some not attached, with some crossveins present between some intercalaries, and with basal attached intercalary not forked; CuA and CuP attached basally by crossveins; A_1 with one attached marginal veinlet in basal half, and without any other veinlets; additional A veins not discernible. Mesonotal sutures, hindwing, and numerous other thoracic and abdominal structures not decipherable. Terminalia not known.

Type Species. *Nanophemera myanmarensis*, n. sp.

Nanophemera myanmarensis, NEW SPECIES

Description. Adult, sex indeterminable. Body length 4.26 mm; forewing length 4.5 mm; foreleg length ca. 2.6 mm; head width including compound eyes 0.55 mm, not including eyes 0.32 mm. Compound eyes well separated on head; length of compound eye greater than length of head; compound eyes degraded laterally in fossil, with width unknown. Details of legs undecipherable. Forewing with some attached marginal intercalaries; CuA and CuP attached by four basal crossveins; six elongate cubital intercalaries present, with first not forked, with first, third, fifth, and sixth attaching CuA with hindmargin, with second and fourth not attached to CuA, with first and third attached to each other basally by crossvein, with fifth and sixth arched basally from CuA, and with fifth attached to CuA sub-basally by crossvein; CuP and A_1 attached by three crossveins; anal system represented only by A_1 and one crossvein attaching it to hindmargin. Hindwing well developed, with MA_2 not detached basally, and with numerous marginal veinlets. Terminalia not present.

Type Data. Adult, sex unknown, in Burmese amber; Tanai Village (on Ledo Road, 105 km NW of Myitkyna), Hukawng Valley, Kachin, Myanmar (Burma), coll. Leeward Capital Corporation, 2003. Probably Upper Cretaceous. Deposited in the Purdue Entomological Research Collection, West Lafayette, Indiana, U.S.A.

DISCUSSION

Nanophemera body size (ca. 4.25 mm) is similar to *Palaeoanthus minutus* Kluge (4.0 mm), and somewhat similar to *Borephemera* (slightly more than 5.0 mm). Other members of the family Australiphemeridae range from 8.5 to ca. 11.0 mm (still small compared to extant burrowers). The cubital intercalary system of the forewings of *Nanophemera* is more complex than that of any other genera of Australiphemeridae, in that some crossvenation is present. Also, CuA is attached basally to CuP by a series of crossveins in *Nanophemera*. Such crossveins are not apparent in *Borephemera* and *Microphemera*, but are most similar to those of

Australiphemera. The first cubital intercalary is forked in *Australiphemera*, *Microphemera*, and *Palaeoanthus*, but is not forked in *Nanophemera* and *Borephemera*. All cubital intercalaries are attached between the CuA and the hindmargin of the wing in *Australiphemera* and *Microphemera* (the geologically older genera), whereas at least some are unattached to CuA in the other genera. The MP₂ arch is also more weakly arched in these older genera (Sinitshenkova 2000a). A₁ is not attached to the hindmargin by a crossvein in *Australiphemera*, *Borephemera*, and *Palaeoanthus*; however, there is one such crossvein in *Nanophemera* and *Microphemera*. There is a distinct difference in the A₁ attaching crossvein in the latter two genera, however, in that the crossvein in *Microphemera* is very slightly arched toward the wing base, and the crossvein in *Nanophemera* is very slightly arched toward the outer part of the wing.

Because there are no larvae known in this family, it remains a presumption that the Australiphemeridae are indeed scaphodont mayflies. Although there is no evidence from the alate stages to suggest they are not scaphodonts, there remains the slight possibility that the family is a pannote group having retained relative primitive wing venation that would have been present in the most recent common ancestor of Pannota and Scaphodonta (as does the most phyletically basal family of pannote mayflies, the Neoephemeridae) but not yet having evolved the tusked burrowing larvae that apomorphically define the Scaphodonta (see McCafferty and Wang 2000). If the larvae of Australiphemeridae prove to be a tusked burrowing mayfly (probably reminiscent of Potamanthidae), then they are clearly primitive scaphodonts. If they prove not to possess tusks, but have basally fused forewing pads and recumbent abdominal gills (probably reminiscent of Neoephemeridae) then they would be primitive pannotes. If the larvae are without any of the larval apomorphies mentioned, then they likely represent a group similar to the most recent common ancestor of the Scaphodonta and Pannota.

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